

**Iowa State University**

---

**From the Selected Works of Andrea S. Wheeler**

---

Spring February 23, 2015

# Green School, Designing for Comfort and Beyond...

Andrea S Wheeler, *Iowa State University*

Naghmeh Pak, *Iowa State University*

Evan Jeanblanc, *Iowa State University*



SELECTEDWORKS™

Available at: [http://works.bepress.com/andrea\\_wheeler/7/](http://works.bepress.com/andrea_wheeler/7/)



# GREEN SCHOOL, Designing for Comfort and Beyond...

## Developing a post-occupancy evaluation tool for schools in Iowa

Wheeler, Andrea; Assistant Professor of Architecture; Pak, Naghmeh, Graduate Research Assistant; Jeanblanc, Evan, Undergraduate Research Assistant  
Iowa State University, Department of Architecture

### Background

Comfort is defined through human senses; sight, hearing, smell, touch, and taste. Each sense can lead to a greater or lesser degree of comfort. However, children experience comfort differently than adults [1]. They experience spaces differently and have different knowledge about the performance of a building than adult users; they can also have a perspective on design quality unlike that of the architect.



**Figure 1:** Sample of a Child friendly Questionnaire

School is a designed environment that a child lives in for over 6 hours a day; it is thus argued simply a matter of a child's right to be consulted about his or her day-to-day environment. However, the reasons that children are not included in post-occupancy evaluations include a trend towards the standardization of methods in order to collect data comparable for building types; a persistent prejudice against the value of children's experiences, deeming children unreliable research participants; and simply the difficulty in developing methods appropriate for children, apart from the typical research methods of interviews and questionnaires. Designing a tool that includes children's perspectives has value not only in terms of improving building performance, and thereby energy performance, but also in delivering the educational objectives of schooling and in ensuring health and wellbeing at both the physical and developmental levels. Indoor Air Quality (IAQ) is well known for its effects on children's health, wellbeing, and educational performance, for example, and daylighting has been proved as equally important. Design and



space provision is a slightly more ambiguous issue in determining linkages with educational performance; nevertheless, studies have examined this [2]; the question of different comfort levels and designing to children's comfort levels in school tends to be limited to specific medical or developmental issues and Special Needs.

**Figure 2 (left):** MiDAS Environmental Measuring Tool

**Figure 3 (right):** Sample of a Data Collector

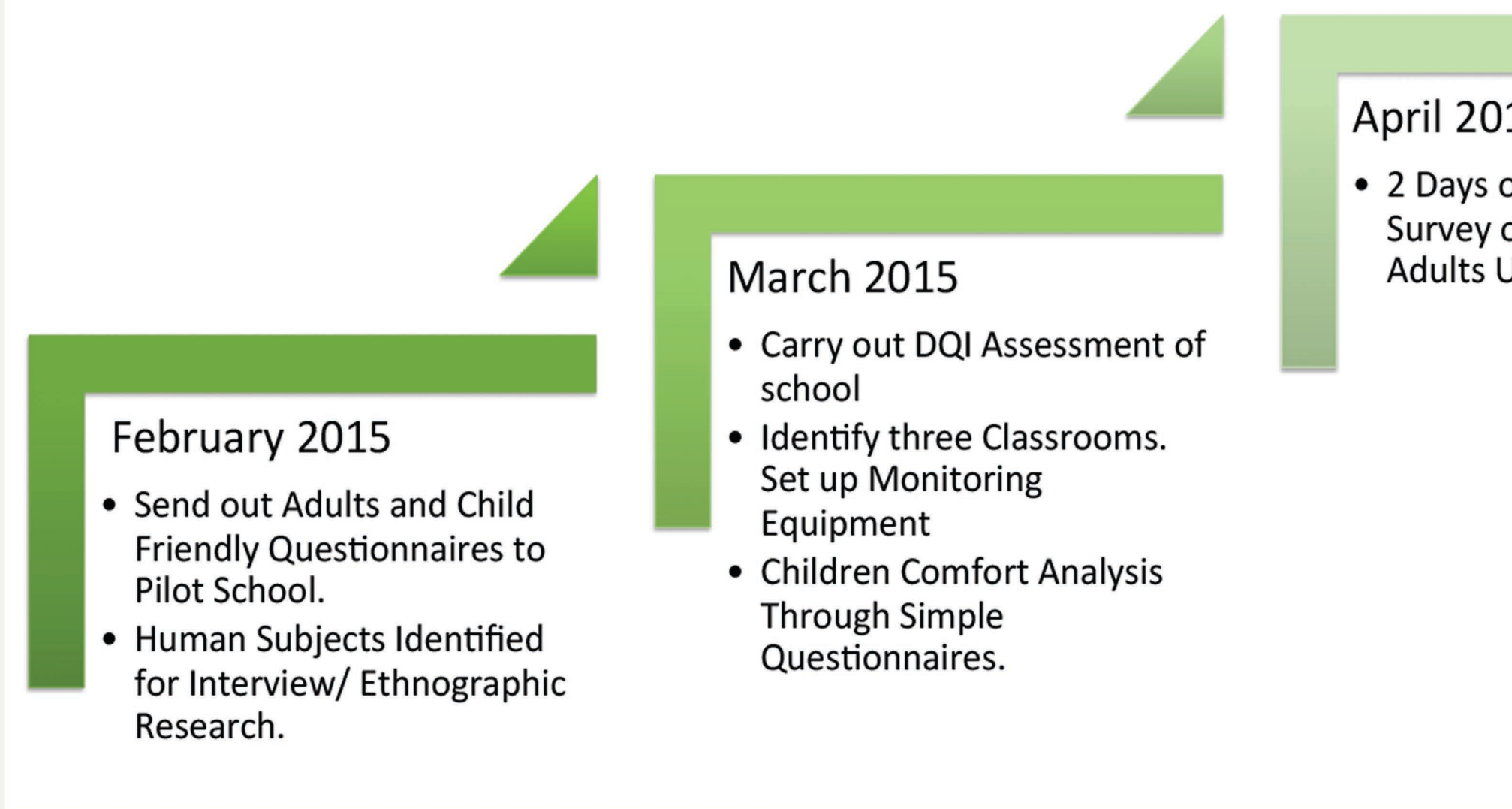


### Methodology

This research critically examines literature on the subject of comfort and explores research determining differences between comfort levels of children and adults. The research provides the first stage in a project which will examine contemporary high-performing, energy-efficient schools built within the last five years in Iowa. The research develops and pilots a building performance assessment tool for schools: firstly, to evaluate the performance of new schools in Iowa in terms of environmental quality, design quality and energy performance—the immediate value of which is in remedying design flaws or building management issues (and may encourage sustainable behaviors) [4]—and, secondly, to collect an evidence base for designing child-centered learning spaces and school buildings, the value of which suggests improved educational performance, psychosocial development and wellbeing.

Children experience comfort differently, as their bodies are different in scale. Toxic chemicals in construction products and finishes can have a greater impact. More than half of the body's intake is inhaled indoors and many illnesses related to environmental exposure

**Table 1:** Pilot Building Assessment/ Post-occupancy evaluation tool schedule



to pollutants are related to Indoor Air Quality (IAQ). [3] The physical impacts of poor environmental design are more easily demonstrated than educational detriments. Children experience space differently at so many different levels. However, whilst it is not only children who experience school buildings day-to-day, school post-occupancy evaluations cannot be concerned only with one user type. Neither can the experience of adults be the only determinant of a good school. Hence, the second, equally important aim of the building performance assessment tool is as a means of collecting evidence for designers to create learning spaces not only at the level of space organization and formal educational features—organization of tables and chairs for example in relation to outdoor spaces—but also at the level of less obvious comfort experiences of the different users: lighting levels, temperature, CO2 levels, sound quality, and pollutants. The position taken in this research is one of determining an appropriate approach which places children's experience of comfort in relation to their learning environments at the center of the conversation on green schools.

### The Pilot

A building assessment / post-occupancy evaluation was developed to examine the key literature in the fields of building performance methodology, healthy buildings, comfort studies and research with children. The tool has a number of stages. The first, initial online questionnaires, investigate building performance, in particular indoor environmental performance, from the user's perspective. For the pilot, this was limited to a standard questionnaire for adults. This collects building performance and comfort information for schools across Iowa, including the pilot school. The second stage is the collection of data as physical measurements, including air temperature, humidity, illumination levels, CO2 levels background noise, and airborne pollutions. Some information about airborne pollutants was already available in the pilot school.

This second stage includes an assessment of design quality based on a standard set of Design Quality Indicators (a method that has previously been used in the UK) by visual inspection [5]. The third is the participation of children in child-friendly questionnaires and "walk-throughs" to assess design quality from their perspective, via prompts to develop conversations on environmental quality—temperature (hot and cold); humidity (sticky or damp); air quality (smelly); CO2 (stuffy); sound levels (noisy); illumination (light or dark). After some evaluation of these data, problem issues will be identified. DQIs discussed with the architect to further investigate and propose solutions. Where environmental measurements and children's perspectives alerted further issues, more detailed investigations will be made. It is anticipated that the method will be critically reviewed after the pilot is complete.

### Conclusion

Designing green schools cannot only address energy conservation, but must address health and wellbeing. Comfort issues cannot be neglected in the design of new and sustainable schools, and comfort understood through the perceptions of children offer a new approach.



[1] Woolner, P., & Hall, E. (2010). Noise in schools: a holistic approach to the issue. International journal of environmental research and public health, 7(8), 3255-3269. [2] Higgins, S., Hall, E., Wall, K., Woolner, P., & McCaughey, C. (2005). The impact of school environments: A literature review. Design Council; PriceWaterHouseCoopers (2000), "Building Performance: An Empirical Assessment of the Relationship between Schools Capital Investment and Pupil Performance", Department for Education and Skills, United Kingdom. www.dfes.gov.uk/research/data/uploads/RR407.pdf. [3] Sundell, J. (2004). On the history of indoor air quality and health. Indoor Air, 14(7), 51-58; [4] Woolner, P., McCarter, S., Wall, K., & Higgins, S. (2012). Changed learning through changed space: When can a participatory approach to the learning environment challenge preconceptions and alter practice? Improving schools, 15(1), 45-60. [5] Cardellino, P., Leiringer, R., & Clements-Croome, D. (2009). Exploring the role of design quality in the building schools for the future programme. Architectural Engineering and Design Management, 5(4), 249-262 [6] Uline, C., & Tschannen-Moran, M. (2008). The walls speak: The interplay of quality facilities, school climate, and student achievement. Journal of Educational Administration, 46(1), 55-73; Gislason, N. (2009). Mapping school design: A qualitative study of the relations among facilities design, curriculum delivery, and school climate. The Journal of Environmental Education, 40(4), 17-34;